

IV. Epigenetic ore bodies.

V. Sulphuretted ore deposits mainly of epigenetic origin.

VI. Ores formed by sedimentation.

VII. Gozzans.

VIII. Secondary (clastic) deposits.

Many of these groups are by no means satisfactory, inasmuch as the deposits included in them do not properly correspond to the titles given. Thus the author quotes as examples of magmatic segregation the magnetites in gneiss of the Lofoten Islands and the Kiruna ore, although he admits that the latter ore deposit is definitely younger than the adjoining eruptive rocks and accordingly not syngenetic with these. Similarly he includes among contact deposits, by which he understands those formed under the influence of contact metamorphism at or near the boundaries of the eruptive and the stratified rock masses, a number of deposits as to which he is bound to admit that he cannot ascribe their origin to any particular eruptive rock. He describes those as krypto-contact deposits, but obviously such a description is far from satisfactory. Among his epigenetic ore bodies he includes such deposits as those of Bingham and Bisbee, where the protore is undoubtedly syngenetic, gash veins and similar deposits in pre-existing cavities, true metasomatic deposits like the red hæmatites of Cumberland, and certain residual deposits, while his group of sulphuretted ore bodies is admittedly not a natural entity and contains examples of syngenetic, epigenetic, and indeterminate modes of origin. This method of dealing with the subject creates confusion rather than clearness; it is conglomeration, not classification.

There are various mistakes in geography, which should have been avoided; for example, the Sierra de Ronda is said to be on the Portuguese coast, and Leadville in England! Moreover, the work aims at describing every deposit of importance, but there are several notable omissions.

No doubt there is room for a good, small text-book on mineral deposits, but it will have to be on different lines from those of the present one; more care will have to be devoted to classification and to the discussion of the modes of formation of the deposits, and fewer examples, and those only typical ones, must be quoted, references to descriptions of others being generally sufficient. It is probably only in this way that the student can get a clear view of this complex subject. The work at present before us does not fulfil these conditions; it may be of use for reference to the experienced mining geologist who is not likely to be led astray by it, but it is scarcely a safe book to place in the hands of a beginner.

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The Living Soil.

Das Edaphon. Untersuchungen zur Ökologie der bodenbewohnenden Mikroorganismen. Von R. H. Francé. Zweite Auflage. Pp. 99. (Stuttgart: Franckh'sche Verlagsbuchhandlung, 1921.)

"EDAPHON" is the name which, from their analogy to the plankton, Dr. Francé has coined to cover all the forms of life occurring in the soil. In spite of the very considerable amount of work that has been done in recent years on these organisms, very little of it is at present available to the general biological reader. There are text-books of agricultural bacteriology and a considerable number of scattered papers dealing with single organisms or groups of organisms from the soil, but most of these reach only the specialist. Dr. Francé has therefore performed a real service in writing a brief general account of the soil fauna and flora, its conditions of life, and the influences of the different groups of organisms on one another and on the soil.

As a general handbook to the subject, however, it suffers from one considerable defect, for during the past few years great advances have been made both in this country and in America, of which apparently Dr. Francé has as yet heard nothing, since he gives no references to any non-German work of a later date than 1912. Even a casual glance through recent numbers of the English and American journals would not only have given him many useful facts, but would also have suggested methods of technique which would have made his own investigations much more fruitful. His accounts in particular of the insects and flagellates give very little idea of the number and variety of these creatures occurring in the soil.

The observations on the ecology of the organisms would also have been more satisfactory if a little more statistical information had been given. It is not very useful to be told that in May a cubic millimetre of soil contained 15 organisms (omitting bacteria), whereas in August the number had fallen to 3, unless we are also told how much variation there is between duplicate samples taken at the same time or at brief intervals. Since Dr. Francé frequently reminds us of the close analogy between the edaphon and the plankton, one naturally recalls the wide divergences found in duplicate catches of the latter. Probably he is right in believing that the figures given are significant, but the reader who wishes to understand what are the effects of temperature, moisture, season, and the physical and chemical properties of the soil on the organisms living in it, is at a great disadvantage if he is not told just what is the degree of significance.

In spite of these defects, however, the present

volume contains a great many useful observations and a very lucid and stimulating review of the subject. One may question whether the biological influences have quite the dominating importance in the soil that is here claimed for them, and in particular whether the organisms found in it can as yet be satisfactorily used as a criterion of the agricultural properties of a soil; but the subject is still young and its possibilities are undoubtedly great.

The Presentation of Thermodynamics.

Vorlesungen über Thermodynamik. Von Prof. Dr. Max Planck. Sechste Auflage. Pp. x + 292. (Berlin: W. De Gruyter und Co., 1921.)

ONE of the most universal generalisations that can be made about the study of mathematical physics is that everybody finds thermodynamics a very difficult subject. In consequence of this there have arisen several different ways of presenting it, which vary far more from one another than do the presentations in such subjects as dynamics or electricity. There is first the thermodynamics of the engineer, in which entropy is something steam has, which can be found from tables. Then there is the thermodynamics of the chemist, whose laboratory is stocked with semi-permeable membranes. He is a great designer of engines, but all his enjoyment of his wonderful instruments is spoiled by his perpetual suspicion that Nature is trying to score off him. Next, there is the thermodynamics of the mathematician; this scraps the chemist's machinery and does the whole business by means of Pfaffian forms, a peculiar branch of mathematics, and almost the only one in which it looks as if more comes out at the end than is put in at the beginning. Lastly, there is the super-man, who can see and count the atoms, who regards all the others as gamblers, though he is bound to admit that they know how to lay the odds. He occupies a position rather apart, being, so to speak, engaged in a study of the jurisprudence of thermodynamics.

Now (excepting the last), all these presentations claim to derive their results from the two laws of thermodynamics, but there is no agreed statement of those two laws. In most books the chapter on the Second Law is not opened by a formal statement of that law—as Newton's laws of motion would head the corresponding chapter in a book on dynamics—but it is necessary to have several pages of tendentious discussion first, to create the atmosphere in which the law shall be acceptable. This can only mean that the law as stated contains a good many implied assumptions. Some years ago Carathéodory, the pure mathematician, formulated the principles in a really

logical manner, and it is to be hoped—if we can believe that the human mind is by taste rational—that this formulation will be more successful in making the subject easy than has the exceptional variety in presentation which has hitherto prevailed. Carathéodory's work was transcribed a year or two ago in the *Physikalische Zeitschrift* by Born. He insists that there is no way of shirking the Pfaffian problem in some form or other, but gives a simple geometrical description of it; in the consequent deduction of absolute temperature and entropy there is some rather heavy work which could probably be simplified. But the most important modification is the new place taken by temperature in the presentation. In the ordinary way it occurs muddled up with the Second Law, but here it is taken out and introduced as the primitive idea—of course, measured on an arbitrary scale. The consequence is that the First Law no longer deals with quantities which are undefined, and the Second Law becomes a clear-cut statement instead of a jumble of two statements.

The new presentation is too recent to have been adopted in text-books, and it will be most interesting to see whether it is destined to drive out the older types. The book under review is of a class about midway between those of the chemist and those of the mathematician. That it has gone through six editions shows that it is a first-rate introduction to the subject; but it certainly can be criticised from the logical point of view, for it brings in absolute temperature by means of the perfect gas, and only later justifies it in the general case. It is a philosophical question whether it is legitimate to introduce ideas connected with reality by means of a hypothetical substance—perhaps it may be defended, like the introduction of rigid bodies in dynamics. But the point really is that this method is apt to leave the student with the idea that absolute temperature is in some way connected with perfect gases, an idea rather encouraged by many of the examples that are usually cited. It is surely a pity to start by dealing with a special case, when the whole argument is that Carnot's cycle works exactly as well whatever the substance in the cylinder. Apart from this criticism, however, the whole work is an admirably detailed development of the theory, with numerous illustrative examples from physical chemistry. The chief changes in the new edition are in connexion with the theory of solutions; in particular, an account is given of the theory of J. C. Ghosh of Calcutta, of the freezing-points of strong solutions, which would seem to have attracted more attention in Germany than in this country. There is also more said about the equation of state of solids and their expansion coefficients.